



# Technical Report Series on the Biosystem-Aerosphere Study (BOREAS)

*Editor*

**85**

**AS Level-0 ER-2**

*mer and R. Dominguez*

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## **Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)**

*Forrest G. Hall, Editor*

### **Volume 85**

### **BOREAS Level-0 ER-2 Aerial Photography**

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# **BOREAS Level-0 ER-2 Aerial Photography**

Jeffrey A. Newcomer, Roseanne Dominguez

## **Summary**

For BOREAS, the ER-2 and other aerial photography was collected to provide finely detailed and spatially extensive documentation of the condition of the primary study sites. The ER-2 aerial photography consists of color-IR transparencies collected during flights in 1994 and 1996 over the study areas.

Note that the level-0 ER-2 photography is not contained on the BOREAS CD-ROM set. An inventory listing file is supplied on the CD-ROM to inform users of the data that were collected. See Section 15 for information about how to acquire actual photographs.

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## **1. Data Set Overview**

### **1.1 Data Set Identification**

BOREAS Level-0 ER-2 Aerial Photography

### **1.2 Data Set Introduction**

The BOREal Ecosystem-Atmosphere Study (BOREAS) Staff Science effort covered those activities that were BOREAS community-level activities or required uniform data collection procedures across sites and time. These activities included the acquisition, processing, and archiving of the digital images and aerial photography collected on the National Aeronautics and Space Administration's (NASA's) ER-2 aircraft.

### **1.3 Objective/Purpose**

For BOREAS, the ER-2 aerial photography, along with the other photography, was collected in order to provide finely detailed and spatially extensive documentation of the condition of the primary study sites.

## **1.4 Summary of Parameters**

Level-0 ER-2 aerial photography in color-infrared (IR) was obtained by the onboard camera system during acquisition of digital images on ER-2 flights in early fall of 1993 and during the 1994 and 1996 digital data collection periods.

## **1.5 Discussion**

BOREAS Information System (BORIS) staff processed the level-0 ER-2 aerial photography by:

- Reviewing the film on the rolls with the flight logs obtained from NASA Ames Research Center (ARC) to check for discrepancies in numbers of frames and coverage
- Compiling the information into spreadsheets for loading into the online data base
- Loading the spreadsheet information into data base tables
- Cross-checking the photographic information against data collected by other instrument systems on the ER-2 aircraft

## **1.6 Related Data Sets**

BOREAS Level-0 AOCI Imagery: Digital Counts in BIL Format

BOREAS Level-0 Daedalus TMS Imagery: Digital Counts in BIL Format

BOREAS RSS-18 Level-1B AVIRIS Imagery: At-sensor Radiance in BIL Format

BOREAS Level-0 C-130 Aerial Photography

# **2. Investigator(s)**

## **2.1 Investigator(s) Name and Title**

BOREAS Staff Science

## **2.2 Title of Investigation**

BOREAS Staff Science Aircraft Data Acquisition Program

## **2.3 Contact Information**

### **Contact 1:**

Jeffrey S. Myers  
Aircraft Data and Sensor Facilities  
NASA Ames Research Center  
MS 240-6 (Bldg. 240, Rm. 219)  
Moffett Field, CA 94035-1000  
(415) 604-6253  
(415) 604-4987 (fax)  
jmyers@msmail.arc.nasa.gov

### **Contact 2:**

Jeffrey A. Newcomer  
Raytheon ITSS  
Code 923  
NASA GSFC  
Greenbelt, MD 20771  
(301) 286-7858  
(301) 286-0239 (fax)  
Jeffrey.Newcomer@gsfc.nasa.gov

### 3. Theory of Measurements

The NASA Earth Resources Aircraft Program at ARC operates the ER-2 aircraft to acquire data for Earth science research. The aerial photographic cameras used on the ER-2 are equipped with film, lenses, and filters needed to meet various photographic needs. For BOREAS, the aerial photography was obtained to help provide fine spatial resolution information about the various intensive measurement sites.

### 4. Equipment

#### 4.1 Sensor/Instrument Description

##### 4.1.1 Collection Environment

As part of the BOREAS Staff Science data collection effort, the ARC High Altitude Aircraft Branch collected and processed color-IR aerial photography to BOREAS level-0 products. The various camera systems were flown on NASA's ER-2 aircraft during the BOREAS mission (see the BOREAS Experiment Plan for flight pattern details and objectives). Maintenance and operation of the cameras are the responsibility of ARC. The ER-2 Experimenter's Handbook (supplemental) produced by the High Altitude Aircraft Branch at ARC provides a description of the systems, calibration procedures, and format.

##### 4.1.2 Source/Platform

NASA's ER-2 Earth Resources Aircraft.

##### 4.1.3 Source/Platform Mission Objectives

The purpose of the aerial photography was to provide detailed spatial resolution information about the sites over which various digital scanner data were obtained.

##### 4.1.4 Key Variables

Reflected radiation.

##### 4.1.5 Principles of Operation

A Wild-Heerbrug RC-10 metric mapping camera was used, with the shutter intervalometer set to acquire frames with a 60% forward overlap to provide stereo coverage.

##### 4.1.6 Sensor/Instrument Measurement Geometry

The BOREAS ER-2 flight altitudes ranged from 19,000 to 20,000-m Above Ground Level (AGL). Generally, one camera acquired photographs using a 304.89-mm focal-length lens, which resulted in photography at scales ranging from 1:62,000 to 1:65,000. The following are the various lens, film, filter, and exposure combinations used:

Camera	Focal Length	Film	Filter	F Stop
RC-10 076	304.89 mm	Aerochrome IR SO-060	Wratten 12	11
RC-10 034	304.66 mm	Aerochrome IR SO-060	Wratten 12	8

The Wild-Heerbrug RC-10 is a metric mapping camera equipped with a shutter intervalometer set to acquire frames with a 60% forward overlap to provide stereo coverage. The RC-10 film can be used to produce standard photogrammetric products or scanned to generate digital orthophotos.

Lens: 304.44-mm (12-inch) focal length/f4  
 Film Format: 240-mm (9.5-inch) 9-inch x 9-inch image area  
 Film Type: Kodak SO-060 Aerochrome IR  
 Filtration: Kodak Wratten 12  
 Spectral Range: 510-900 nm  
 Shutter Speed: 1/200  
 Ground Coverage: 15 km x 15 km from ER-2 altitude of  
 19.8 km/65,000 ft  
 Scale: 1:65,000  
 Resolution: 1.5-4 m (nominal)

#### 4.1.7 Manufacturer of Sensor/Instrument

Wild-Heerbrug

#### 4.2 Calibration

The RC-10 cameras are regularly calibrated by the Optical Science Laboratory of the U.S. Geological Survey (USGS) in Reston, VA.

##### 4.2.1 Specifications

The wavelength ranges (in micrometers) of film/filter combinations used are:

Film -----	Filter -----	Effective Wavelength -----
Aerochrome IR SO-060	Wratten 12	0.510-0.900 mm

##### DESIGN DATA:

Camera	RC-10 076
F-Stop	11
Lens focal length	30.489 cm
Camera	RC-10 034
F-Stop	8
Lens focal length	30.466 cm

##### 4.2.1.1 Tolerance

None given.

##### 4.2.2 Frequency of Calibration

The RC-10 cameras are regularly calibrated by the Optical Science Laboratory of the USGS in Reston, VA.

##### 4.2.3 Other Calibration Information

None given.



## 5. Data Acquisition Methods

As part of the BOREAS Staff Science data collection effort, the ARC High Altitude Aircraft Branch collected and processed color-IR aerial photography to BOREAS level-0 products. The various camera systems were flown on NASA's ER-2 aircraft during the BOREAS mission (see the BOREAS Experiment Plan for flight pattern details and objectives). Maintenance and operation of the cameras are the responsibility of ARC. The ER-2 Experimenter's Handbook (supplemental) produced by the High Altitude Aircraft Branch at ARC provides a description of the systems, calibration procedures, and format.

## 6. Observations

### 6.1 Data Notes

None.

### 6.2 Field Notes

Flight summary reports are available.

## 7. Data Description

### 7.1 Spatial Characteristics

The BOREAS level-0 photographic images cover portions of the Southern Study Area (SSA) and the Northern Study Area (NSA). A few photographs were acquired for the transect area between the SSA and the NSA. The SSA and the NSA are located in the southwest and northeast portions of the overall BOREAS region.

#### 7.1.1 Spatial Coverage

The North American Datum of 1983 (NAD83) corner coordinates of the SSA are:

	Latitude	Longitude
	-----	-----
Northwest	54.321 N	106.228 W
Northeast	54.225 N	104.237 W
Southwest	53.515 N	106.321 W
Southeast	53.420 N	104.368 W

The NAD83 corner coordinates of the NSA are:

	Latitude	Longitude
	-----	-----
Northwest	56.249 N	98.825 W
Northeast	56.083 N	97.234 W
Southwest	55.542 N	99.045 W
Southeast	55.379 N	97.489 W

#### 7.1.2 Spatial Coverage Map

Not available.

### 7.1.3 Spatial Resolution

The BOREAS ER-2 flight altitudes ranged from 19,000 to 20,000-m AGL. Generally, one camera acquired photographs using a 304.8-mm focal-length lens, which resulted in photography at scales ranging from 1:62,000 to 1:65,000. The ground resolution is nominally 1.5-4 m.

### 7.1.4 Projection

Not applicable.

### 7.1.5 Grid Description

Not applicable.

## 7.2 Temporal Characteristics

### 7.2.1 Temporal Coverage

The photographs were collected during BOREAS' Intensive Field Campaigns (IFCs) and the Focused Field Campaign-Thaw (FFC-T), covering the periods of 12-Apr-1994 through 19-Sep-1994 and 07-Mar-1996 and 14-Aug-1996.

### 7.2.2 Temporal Coverage Map

Not available.

### 7.2.3 Temporal Resolution

Images were acquired at the following range of dates for each campaign.

```

                Dates
-----
12-Apr-1994 -- 02-May-1994
24-May-1994 -- 16-Jun-1994
19-Jul-1994 -- 08-Aug-1994
30-Aug-1994 -- 19-Sep-1994
07-Mar-1996
14-Aug-1996
```

## 7.3 Data Characteristics

### 7.3.1 Parameter/Variable

The actual photographs are color-IR transparencies. The parameters contained in the inventory listing file on the CD-ROM are:

```

                Column Name
-----
SPATIAL_COVERAGE
DATE_OBS
START_TIME
END_TIME
ER2_START_LATITUDE
ER2_START_LONGITUDE
ER2_END_LATITUDE
ER2_END_LONGITUDE
ER2_MISSION_ID
ER2_START_PT
ER2_END_PT
PLATFORM_TRACKING
PLATFORM_ALTITUDE
```

SENSOR\_ID  
 FOCAL\_LENGTH  
 FILM\_TYPE  
 START\_FRAME\_NUM  
 END\_FRAME\_NUM  
 CLOUD\_COVER  
 PHOTO\_QUALITY  
 COMMENTS

### 7.3.2 Variable Description/Definition

The actual photographs are analog pictures captured on transparency film depicting the ground area below the ER-2 aircraft in color-IR. The descriptions of the parameters contained in the inventory listing file on the CD-ROM are:

Column Name	Description
SPATIAL_COVERAGE	The general term used to denote the spatial area over which the data were collected.
DATE_OBS	The date on which the data were collected.
START_TIME	The starting Greenwich Mean Time (GMT) for the data collected.
END_TIME	The ending Greenwich Mean Time (GMT) for the data collected.
ER2_START_LATITUDE	The NAD83 based latitude coordinate at the start of an ER2 flight line as given in the flight summary reports.
ER2_START_LONGITUDE	The NAD83 based longitude coordinate at the start of an ER2 flight line as given in the flight summary reports.
ER2_END_LATITUDE	The NAD83 based latitude coordinate at the end of an ER2 flight line as given in the flight summary reports.
ER2_END_LONGITUDE	The NAD83 based longitude coordinate at the end of an ER2 flight line as given in the flight summary reports.
ER2_MISSION_ID	The mission identifier assigned to the ER2 mission in the form of YY-DDD where YY is the last two digits of the fiscal year, and DDD is the deployment number. An example would be 94-120.
ER2_START_PT	The identifier assigned to the starting point of the BOREAS ER2 flight line.
ER2_END_PT	The identifier assigned to the ending point of the BOREAS ER2 flight line.
PLATFORM_TRACKING	The azimuthal direction in which the data collection platform was traveling while collecting the data; expressed as degrees clockwise from North.
PLATFORM_ALTITUDE	The nominal altitude of the data collection platform above the target.
SENSOR_ID	The identifier given to the sensor/instrument that collected the data.
FOCAL_LENGTH	The focal length of the lens that was mounted on the camera during the time that the photography was acquired.

FILM_TYPE	The type of photographic film that was used to acquire the imagery. An example is AEROCHROME MS 2448.
START_FRAME_NUM	The starting frame number for this line and run of the flight.
END_FRAME_NUM	The ending frame number for this line and run of the flight.
CLOUD_COVER	The data analyst's assessment of the cloud cover that exists in the data.
PHOTO_QUALITY	The provided or assessed quality of the photograph(s).
COMMENTS	Descriptive information to clarify or enhance the understanding of the other entered data

### 7.3.3 Unit of Measurement

There is no unit of measurement for the photographs. The measurement units for the parameters contained in the inventory listing file on the CD-ROM are:

Column Name	Units
SPATIAL_COVERAGE	[none]
DATE_OBS	[DD-MON-YY]
START_TIME	[HHMM GMT]
END_TIME	[HHMM GMT]
ER2_START_LATITUDE	[degrees]
ER2_START_LONGITUDE	[degrees]
ER2_END_LATITUDE	[degrees]
ER2_END_LONGITUDE	[degrees]
ER2_MISSION_ID	[none]
ER2_START_PT	[none]
ER2_END_PT	[none]
PLATFORM_TRACKING	[degrees]
PLATFORM_ALTITUDE	[meters]
SENSOR_ID	[none]
FOCAL_LENGTH	[millimeters]
FILM_TYPE	[none]
START_FRAME_NUM	[unitless]
END_FRAME_NUM	[unitless]
CLOUD_COVER	[none]
PHOTO_QUALITY	[none]
COMMENTS	[none]

### 7.3.4 Data Source

NASA ARC Aircraft Data and Sensor Facilities RC-10 aerial mapping cameras are the source of the photography. The source of the parameter values contained in the inventory listing file on the CD-ROM are:

Column Name	Data Source
SPATIAL_COVERAGE	[Assigned by BORIS staff from spatial information]
DATE_OBS	[Extracted from flight summary report]
START_TIME	[Extracted from flight summary report]
END_TIME	[Extracted from flight summary report]
ER2_START_LATITUDE	[Extracted from flight summary report]

ER2_START_LONGITUDE	[Extracted from flight summary report]
ER2_END_LATITUDE	[Extracted from flight summary report]
ER2_END_LONGITUDE	[Extracted from flight summary report]
ER2_MISSION_ID	[Extracted from flight summary report]
ER2_START_PT	[Extracted from flight summary report]
ER2_END_PT	[Extracted from flight summary report]
PLATFORM_TRACKING	[Extracted from flight summary report]
PLATFORM_ALTITUDE	[Extracted from flight summary report]
SENSOR_ID	[Extracted from flight summary report]
FOCAL_LENGTH	[Extracted from flight summary report]
FILM_TYPE	[Extracted from flight summary report]
START_FRAME_NUM	[Derived from review of film rolls]
END_FRAME_NUM	[Derived from review of film rolls]
CLOUD_COVER	[Extracted from flight summary report]
PHOTO_QUALITY	[Extracted from flight summary report]
COMMENTS	[Extracted from flight summary report]

### 7.3.5 Data Range

There is no data range information for the aerial photographs. The following table gives information about the parameter values found in the inventory table on the CD-ROM.

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Clcltd
SPATIAL_COVERAGE	N/A	N/A	None	None	None	None
DATE_OBS	19-APR-94	14-AUG-96	None	None	None	None
START_TIME	1524	2043	None	None	None	None
END_TIME	1528	2045	None	None	None	None
ER2_START_LATITUDE	52.99333	56.12833	None	None	None	None
ER2_START_LONGITUDE	-106.5833	-97.54167	None	None	None	None
ER2_END_LATITUDE	43.91667	56.10167	None	None	None	None
ER2_END_LONGITUDE	-106.8033	-97.75667	None	None	None	None
ER2_MISSION_ID	94-079	96-161	None	None	None	None
ER2_START_PT	1	Y	None	None	None	None
ER2_END_PT	2	Z	None	None	None	None
PLATFORM_TRACKING	0	359	None	None	None	None
PLATFORM_ALTITUDE	16762	20147	None	None	None	None
SENSOR_ID	N/A	N/A	None	None	None	None
FOCAL_LENGTH	304.66	304.89	None	None	None	None
FILM_TYPE	N/A	N/A	None	None	None	None
START_FRAME_NUM	103	6846	None	None	None	None
END_FRAME_NUM	108	6851	None	None	None	None
CLOUD_COVER	N/A	N/A	None	None	None	Blank
PHOTO_QUALITY	N/A	N/A	None	None	None	None
COMMENTS	N/A	N/A	None	None	None	None

Minimum Data Value -- The minimum value found in the column.

Maximum Data Value -- The maximum value found in the column.

Missng Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the parameter value, but the attempt was unsuccessful.

Unrel Data Value -- The value that indicates unreliable data. This is used to indicate an attempt was made to determine the

parameter value, but the value was deemed to be unreliable by the analysis personnel.

Below Detect Limit -- The value that indicates parameter values below the instruments detection limits. This is used to indicate that an attempt was made to determine the parameter value, but the analysis personnel determined that the parameter value was below the detection limit of the instrumentation.

Data Not Cllctd -- This value indicates that no attempt was made to determine the parameter value. This usually indicates that BORIS combined several similar but not identical data sets into the same data base table but this particular science team did not measure that parameter.

Blank -- Indicates that blank spaces are used to denote that type of value.

N/A -- Indicates that the value is not applicable to the respective column.

None -- Indicates that no values of that sort were found in the column.

-----

## 7.4 Sample Data Record

Sample data records are not applicable to the aerial photographs. The following are wrapped versions of the first few records from the level-0 ER-2 Photography inventory table on the CD-ROM:

```
DATE_OBS, SPATIAL_COVERAGE, START_TIME, END_TIME, ER2_START_LATITUDE,
ER2_START_LONGITUDE, ER2_END_LATITUDE, ER2_END_LONGITUDE, ER2_MISSION_ID,
ER2_START_PT, ER2_END_PT, PLATFORM_TRACKING, PLATFORM_ALTITUDE, SENSOR_ID,
FOCAL_LENGTH, FILM_TYPE, START_FRAME_NUM, END_FRAME_NUM, CLOUD_COVER, PHOTO_QUALITY,
COMMENTS
19-APR-94, 'SSA', 1801, 1804, 53.06333, -105.7, 53.38333, -105.705, '94-079', 'A', 'B',
359.0, 19477.0, 'RC10-076', 304.89, 'AEROCROME IR SO-060', 2785, 2791, '', 'GOOD',
'CLEAR'
19-APR-94, 'SSA', 1810, 1818, 53.43167, -106.265, 54.31167, -106.265, '94-079', 'C', 'D',
0.0, 19202.0, 'RC10-076', 304.89, 'AEROCROME IR SO-060', 2792, 2809, '', 'GOOD', 'CLEAR'
19-APR-94, 'SSA', 1821, 1826, 54.09167, -106.0733, 53.55833, -106.2433, '94-079', 'E', 'F',
191.0, 19080.0, 'RC10-076', 304.89, 'AEROCROME IR SO-060', 2810, 2820, '', 'GOOD',
'CLEAR'
```

## 8. Data Organization

### 8.1 Data Granularity

The smallest orderable unit of data for level-0 ER-2 photography is an individual photographic frame. The frames are attached together on a large roll delivered by ARC to BORIS at GSFC.

### 8.2 Data Format(s)

The 9-inch x 9-inch (229-mm x 229-mm) photographs from single or multiple flight lines are attached together on a large roll delivered by ARC to BORIS at GSFC. Review of the film using a light table is encouraged before ordering copies.

The CD-ROM inventory listing file consists of numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

## **9. Data Manipulations**

### **9.1 Formulae**

#### **9.1.1 Derivation Techniques and Algorithms**

Standard photographic processing of the original negatives to positive transparencies was performed based on the manufacturer's film developing specifications.

### **9.2 Data Processing Sequence**

#### **9.2.1 Processing Steps**

BORIS staff processed the level-0 ER-2 aerial photography by:

- Reviewing the film on the rolls with the flight logs obtained from ARC to check for discrepancies in numbers of frames and coverage
- Compiling the information into spreadsheets for loading into the online data base
- Loading the spreadsheet information into data base tables
- Cross-checking the photographic information against data collected by other data systems on the ER-2 aircraft

#### **9.2.2 Processing Changes**

None.

### **9.3 Calculations**

#### **9.3.1 Special Corrections/Adjustments**

None.

#### **9.3.2 Calculated Variables**

Not applicable.

### **9.4 Graphs and Plots**

None.

## **10. Errors**

### **10.1 Sources of Error**

None given.

### **10.2 Quality Assessment**

#### **10.2.1 Data Validation by Source**

Ames and BORIS personnel reviewed the film for overall quality by viewing the resultant photographic images.

#### **10.2.2 Confidence Level/Accuracy Judgment**

Confidence is high that the photographs do in fact cover the areas that are indicated in the flight logs and that the film, filter, and lenses shown are the ones that were used.

#### **10.2.3 Measurement Error for Parameters**

None.

#### **10.2.4 Additional Quality Assessments**

None.

#### **10.2.5 Data Verification by Data Center**

BORIS staff processed the level-0 ER-2 aerial photography by:

- Reviewing the film on the rolls with the flight logs obtained from ARC to check for discrepancies in numbers of frames and coverage
- Compiling the information into spreadsheets for loading into the online data base
- Loading the spreadsheet information into data base tables
- Cross-checking the photographic information against data collected by other data systems on the ER-2 aircraft

### **11. Notes**

#### **11.1 Limitations of the Data**

To date, no discrepancies or problems have been noted in the film.

#### **11.2 Known Problems with the Data**

None.

#### **11.3 Usage Guidance**

None.

#### **11.4 Other Relevant Information**

None.

### **12. Application of the Data Set**

The photography can be used in conjunction with other digital image data as ground truth for various land cover analyses.

### **13. Future Modifications and Plans**

None.

### **14. Software**

#### **14.1 Software Description**

While reviewing the film and flight logs, BORIS personnel compiled information in Excel spreadsheet files for use in loading the online data base. The Excel spreadsheet files were then loaded into the data base with existing Oracle utilities.

#### **14.2 Software Access**

Contact Microsoft or Oracle Corporation.



## **15. Data Access**

The level-0 ER-2 aerial photography is available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

### **15.1 Contact Information**

For BOREAS data and documentation please contact:

ORNL DAAC User Services  
Oak Ridge National Laboratory  
P.O. Box 2008 MS-6407  
Oak Ridge, TN 37831-6407  
Phone: (423) 241-3952  
Fax: (423) 574-4665  
E-mail: [ornldaac@ornl.gov](mailto:ornldaac@ornl.gov) or [ornl@eos.nasa.gov](mailto:ornl@eos.nasa.gov)

### **15.2 Data Center Identification**

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics  
<http://www-eosdis.ornl.gov/>.

### **15.3 Procedures for Obtaining Data**

Users may obtain data directly through the ORNL DAAC online search and order system [<http://www-eosdis.ornl.gov/>] and the anonymous FTP site [<ftp://www-eosdis.ornl.gov/data/>] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

### **15.4 Data Center Status/Plans**

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

## **16. Output Products and Availability**

### **16.1 Tape Products**

Not applicable to photographic images.

### **16.2 Film Products**

Color-IR aerial photographs and video records were collected. The video record includes pilot-to-ground conversations and an audible tone that was initiated each time the digital scanner systems were triggered. The BOREAS data base contains an inventory of available BOREAS aircraft flight documentation, such as flight logs and videos.

### **16.3 Other Products**

Although the photograph inventory is contained on the BOREAS CD-ROM set, the actual level-0 ER-2 photographs are not. See Section 15 for information about how to obtain the data.

## **17. References**

### **17.1 Platform/Sensor/Instrument/Data Processing Documentation**

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### **17.2 Journal Articles and Study Reports**

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Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. *Journal of Geophysical Research* 102 (D24): 28,731-28,770.

### **17.3 Archive/DBMS Usage Documentation**

None.

## **18. Glossary of Terms**

None.

## 19. List of Acronyms

AGL	- Above Ground Level
AOCI	- Airborne Ocean Color Imager
ARC	- Ames Research Center
ASCII	- American Standard Code for Information Interchange
AVIRIS	- Airborne Visible and Infrared Imaging Spectrometer
BIL	- Band Interleaved by Line
BOREAS	- BOReal Ecosystem-Atmosphere Study
BORIS	- BOREAS Information System
CCT	- Computer Compatible Tape
CD-ROM	- Compact Disk-Read-Only Memory
DAAC	- Distributed Active Archive Center
DAT	- Digital Archive Tape
DN	- Digital Number
DTMS	- Daedalus Thematic Mapper Simulator
EOS	- Earth Observing System
EOSDIS	- EOS Data and Information System
FFC-T	- Focused Field Campaign - Thaw
fPAR	- fraction of Photosynthetically Active Radiation
GIS	- Geographic Information System
GMT	- Greenwich Mean Time
GSFC	- Goddard Space Flight Center
IFC	- Intensive Field Campaign
IFOV	- Instantaneous Field-of-View
I/O	- Input/Output
IR	- Infrared
LAI	- Leaf Area Index
NAD83	- North American Datum of 1983
NASA	- National Aeronautics and Space Administration
NIST	- National Institute of Standards and Technology
NSA	- Northern Study Area
ORNL	- Oak Ridge National Laboratory
PANP	- Prince Albert National Park
RSS	- Remote Sensing Science
SRF	- Spectral Response Function
SSA	- Southern Study Area
TM	- Thematic Mapper
TMS	- Thematic Mapper Simulator
μm	- micrometers
URL	- Uniform Resource Locator
USGS	- U.S. Geological Survey

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